RADIO COMMUNICATION SYSTEM, MOBILE STATION, BASE STATION AND RADIO NETWORK CONTROLLER

CROSS REFERENCE TO RELATED APPLICATION

This application is based upon and claims the benefit of priority from the prior Japanese Patent Application No. P2002-274144, filed on September 19, 2002; and P2003-089240, filed on March 27, 2003; the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a radio communication system performing multicast communication, a mobile station, a base station and a radio network controller.

2. Description of the Related Art

As shown in FIG. 1, broadcast communication whereby a plurality of base stations 11 to 17 transmit common information to unspecified mobile stations 101 to 112 in predetermined areas is known in a conventional radio communication system.

As shown in FIG. 2, multicast communication whereby a plurality of base stations 11 to 17 transmit common information to specific mobile stations joining in (belonging to) a specific group is known in a conventional radio communication system.

However, there is a problem in that a plurality of mobile stations joining in a multicast group receive a controls signal for the multicast group at approximately the same time, and a

plurality of response signals are transmitted to the radio network controller at approximately the same time, so that the load on receiving controlling and processing of the radio network controller is increased as the number of response signals increases in the conventional multicast communication.

BRIEF SUMMARY OF THE INVENTION

In viewing of the foregoing, it is an object of the present invention to provide a radio communication system which can reduce the load on the radio network controller during the multicast communication, a mobile station, a base station and a radio network controller which can be used in the above radio communication system.

A first aspect of the present invention is summarized as a radio communication system having a radio network controller, base stations and mobile stations, to perform multicast communication.

The mobile station comprises a response signal transmitter configured to transmit a response signal including a group ID identifying a multicast group to the base station. The response signal responds to a control signal for the multicast group which the mobile station is joining in.

The base station comprises a response signal transmitter configured to transmit at least one response signal to the radio network controller. The at least one response signal is selected from at least one response signal transmitted from mobile stations joining in the same multicast group.

A second aspect of the present invention is summarized

as a mobile station supporting multicast communication. The mobile station comprises a response signal transmitter configured to transmit a response signal including a group ID identifying a multicast group to a base station. The response signal responds to a control signal for the multicast group which the mobile station is joining in.

A third aspect of the present invention is summarized as a base station supporting multicast communication. The base station comprises a response signal transmitter configured to transmit at least one response signal to the radio network controller. The at least one response signal responds to a control signal for a multicast group, and is selected from at least one response signal transmitted from mobile stations joining in the same multicast group.

In the third aspect, the base station may further comprise a response signal holder configured to hold the at least one response signal for a predetermined duration before transmitting the at least one response signal to the radio network controller.

In the third aspect, the base station may further comprise a detector configured to detect a first reception of the at least one response signal transmitted from the mobile stations. The response signal holder may hold the at least one response signal for a predetermined duration after the first reception of the at lease one response signal.

A fourth aspect of the present invention is summarized as a radio communication system having a radio network controller, base stations and mobile stations, to perform multicast communication.

The mobile station comprises a response signal transmitter configured to transmit a response signal including a group ID identifying a multicast group to the base station. The response signal responds to a control signal for the multicast group which the mobile station is joining in.

The base station comprises a response signal counter configured to count the number of response signals transmitted from the mobile station joining in the same multicast group, a judger configured to judge whether the counted number of response signals is more than a predetermined number or not, and a response signal transmitter configured to transmit at least one response signal to the radio network controller when the counted number of response signals is more than the predetermined number.

A fifth aspect of the present invention is summarized as a base station supporting multicast communication. The base station comprises a response signal counter, a judger and a response signal transmitter.

The response signal counter is configured to count the number of response signals to a control signal for a multicast group. The response signals are transmitted from mobile stations joining in the same multicast group.

The judger is configured to judge whether the counted number of response signals is more than a predetermined number or not.

The response signal transmitter is configured to transmit at least one response signal to a radio network controller, when the counted number of response signals is more than the predetermined number.

In the fifth aspect, the response signal transmitter may notify that the counted number of response signals is more than the predetermined number, or the counted number of response signals, to the radio network controller.

A sixth aspect of the present invention is summarized as a radio network controller supporting multicast communication. The radio network controller comprises a receiver configured to receive response signals transmitted from base stations, a extractor configured to extract information showing that the number of received response signals is more than a predetermined number from the received response signals and a radio controller configured to perform a radio controlling in multicast communication in accordance with the extracted information.

A seventh aspect of the present invention is summarized as a radio network controller supporting multicast communication. The radio network controller comprises a receiver configured to receive response signals transmitted from base stations, a extractor configured to extract the number of received response signals from the received response signals and a radio controller configured to perform a radio controlling in multicast communication in accordance with the extracted number of response signals.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a diagram for explaining broadcast communication according to the prior art.

FIG. 2 is a diagram for explaining multicast communication according to the prior art.

FIG. 3 is a diagram showing the entire configuration of a radio communication system according to embodiments of the present invention.

FIG. 4 is a functional block diagram of a mobile station in the radio communication system according to a first embodiment.

FIG. 5 is a functional block diagram of a base station in the radio communication system according to the first embodiment.

FIG. 6 is a sequence diagram illustrating the operation of the radio communication system according to the first embodiment.

FIG. 7 is a functional block diagram of a base station in the radio communication system according to a second embodiment.

FIG. 8 is a sequence diagram illustrating the operation of the radio communication system according to the second embodiment.

FIG. 9 is a functional block diagram of a base station in the radio communication system according to a third embodiment.

FIG. 10 is a sequence diagram illustrating the operation of the radio communication system according to the third embodiment.

FIG. 11 is a functional block diagram of a base station in the radio communication system according to a fourth embodiment.

FIG. 12 is a sequence diagram illustrating the operation of the radio communication system according to the fourth

embodiment.

FIG. 13 is a functional block diagram of a base station in the radio communication system according to a fifth embodiment.

FIG. 14 is a functional block diagram of a radio network controller in the radio communication system according to the fifth embodiment.

DETAILED DESCRIPTION OF THE INVENTION

<A configuration of a radio communication system according to a first embodiment of the present invention>

FIG. 3 shows the entire configuration of a radio communication system according to a first embodiment of the present invention.

As shown in FIG. 3, the radio communication system according to the embodiment comprises four base stations 10, 20, 30 and 40 under a radio network controller 50.

In the radio communication system according to the embodiment, the base station 10 manages mobile stations 11 to 13, the base station 20 manages mobile stations 21 and 22, the base station 30 manages mobile stations 31 and 32, and the base station 40 manages mobile stations 41 to 43. The mobile stations 11, 12, 21, 41, 42 and 43 join in the same multicast group A in the embodiment.

FIG. 4 shows a functional block diagram of the mobile station used in the radio communication system according to the embodiment. Functions of a plurality of mobile stations 11 to 43 are basically the same, so that the function of the mobile

station 11 will be explained as follows.

As shown in FIG. 4, the mobile station 11 is configured with a control signal receiver 11a, a response signal transmitter 11b and a response signal creator 11c. The mobile station 11 can support multicast communication.

The control signal receiver 11a is configured to receive a control signal for the multicast group A. The control signal for the multicast group A is transmitted from the base station 10.

The response signal creator 11c is configured to create a response signal to the control signal for the multicast group A. The response signal includes a group ID identifying a multicast group.

The response signal transmitter 11b is configured to transmit the response signal to the base station 10 after holding the response signal.

FIG. 5 shows a functional block diagram of the base station used in the radio communication system according to the embodiment. Functions of a plurality of base stations 10 to 40 are basically the same, so that the function of the base station 10 will be explained as follows.

As shown in FIG. 5, the base station 10 is configured with a mobile station signal receiver 10a, a control signal receiver 10b, a multicast group indentifier 10c, a response signal creator 10d and a transmitter 10e.

The mobile station signal receiver 10a is configured to receive at least one response signal from a plurality of mobile stations 11 to 13.

The control signal receiver 10b is configured to receive

a control signal for a multicast group from the radio network controller 50.

The mobile station signal receiver 10a and the control signal receiver 10b may be configured with the same unit.

The multicast group indentifier 10c is configured to identify whether the received response signal is transmitted from the mobile station joining in the same multicast group.

The response signal creator 10d is configured to create at least one response signal (for example, a predetermined number of response signals) to be transmitted to the radio network controller 50, by extracting at least one response signal from at least one response signal transmitted from the mobile stations.

The response signal creator 10d may create at least one response signal to be transmitted to the radio network controller 50, by changing a format of the at least one response signal after extracting the at least one response signal from at least one response signal transmitted from the mobile stations.

The predetermined numbers (for example, one, two and so on) set up in each base station can be different.

The transmitter 10e is configured to transmit the control signal for the multicast group to the mobile station.

The transmitter 10e is configured to transmit the at least one response signal created by the response signal creator 10d to the radio network controller 50.

The transmitter 10e can transmit the control signal to the mobile stations after the expiration of a predetermined duration (for example, a random duration). The predetermined

durations set up in each base station can be different.

<An operation of the radio communication system according to the first embodiment >

Referring to FIG. 6, the operation whereby the radio network controller 50 performs a predetermined processing (for example, a service notice processing) on the mobile stations 11, 12, 21, 41, 42, 43 joining in the multicast group A in the radio communication system according to the embodiment will be described.

As shown in FIG. 6, in step 1001, the radio network controller 50 transmits a control signal such as a service notice signal and an authentication signal to three base stations 10, 20 and 40.

In step 1002, each of the base stations 10, 20 and 40 receives the control signal transmitted from the radio network controller 50. The control signals transmitted by each of the base stations 10, 20 and 40 reach the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A under the base stations 10, 20 and 40.

In step 1003, each of the mobile stations 11, 12, 21, 41, 42 and 43 creates a response signal including a group ID. It is thus possible to identify that each of the mobile stations 11, 12, 21, 41, 42 and 43 is joining in the multicast group A with the group ID. Each of the mobile stations 11, 12, 21, 41, 42 and 43 respectively transmits the created response signal to the base stations 10, 20 and 40.

In step 1004, each of the base stations 10, 20 and 40 receives at least one response signal from each of the mobile

stations 11, 12, 21, 41, 42 and 43, and identifies whether each of the response signals is transmitted from mobile stations joining in the same multicast group or not.

In the embodiment, each of the base stations 10, 20 and 40 identifies whether each of the response signals is transmitted from mobile stations joining in the multicast group A or not.

The base station 10 receives two response signals from the mobile stations 11 and 12 joining in the multicast group A. The base station 20 receives one response signal from the mobile stations 21 joining in the multicast group A. The base station 30 receives three response signals from the mobile stations 41, 42 and 43 joining in the multicast group A. In the base station 10, 20 and 40, six response signals are detected in total. The base station 30 does not receive any response signal from mobile stations 41, 42 and 43 joining in the multicast group A.

Next, each of the base stations 10, 20 and 40 selects at least one response signal (for example, two response signals) from at least one received response signal, and transmits the at least one selected response signal to the radio network controller 50. Each of the base stations 10, 20 and 40 may transmit a signal merging the at least one response signal transmitted from a plurality of mobile stations.

In the embodiment, the base station 10 selects at least one response signal transmitted from the mobile station 11 for transmission to the radio network controller 50, the base station 20 selects at least one response signal transmitted from the mobile station 21 for transmission to the radio network

controller 50, the base station 40 selects at least one response signal transmitted from the mobile station 41 for transmission to the radio network controller 50.

In step 1005, the radio network controller 50 transmits service data to the base stations 10, 20 and 40 in accordance with the at least one response signal transmitted from each of the mobile stations 11, 21 and 41. In other words, the radio network controller 50 performs delivery controlling in accordance with the at least one response signal transmitted from each of the mobile stations 11, 21 and 41.

In step 1006, each of the base stations 10, 20 and 40 transmits the received service data to each of the mobile stations 11, 12, 21, 41, 42 and 43.

<Functions and effects of the radio communication system according to the first embodiment >

The radio communication system according to the first embodiment can reduce the load on the receiving processing and controlling performed by the radio network controller 50, by transmitting a signal merging a plurality of response signals (common information) into one (or a predetermined number) to the radio network controller 50, when control signals for a multicast group are received in a plurality of mobile stations at approximately the same time like multicast communication or broadcast communication, and the response signals increase.

<A configuration of a radio communication system according to a second embodiment of the present invention>

The present invention is not limited to the first

embodiment, and can be applied to a radio communication system according to a second embodiment which further comprises a response signal holder 10f as shown in FIG. 7.

The radio communication system according to the second embodiment is the same as the radio communication system according to the first embodiment except for the response signal holder 10f. Therefore mainly the difference between both radio communication systems will be explained.

The response signal holder 10f is configured to hold the at least one response signal for a predetermined duration (for example, a random duration) before transmitting the at least one response signal to the radio network controller 50. The at least one response signal responds to the control signal for the multicast group A. The predetermined durations set up in each base station are different.

The response signal creator 10d is configured to create, in accordance with the at least one response signal held for the random duration by the response signal holder 10f, at least one response signal to be transmitted.

<An operation of the radio communication system according to the second embodiment >

Referring to FIG. 8, the operation whereby the radio network controller 50 performs a predetermined processing (for example, a service notice processing) on the mobile stations 11, 12, 21, 41, 42, 43 joining in the multicast group A in the radio communication system according to the embodiment will be described.

As shown in FIG. 8, in step 1001, the radio network

controller 50 transmits a control signal such as a service notice signal and an authentication signal to three base stations 10, 20 and 40.

In step 1002, each of the base stations 10, 20 and 40 receives the control signal transmitted from the radio network controller 50. The control signals transmitted by each of the base stations 10, 20 and 40 reach the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A under the base stations 10, 20 and 40.

In step 1003, each of the mobile stations 11, 12, 21, 41, 42 and 43 creates a response signal including a group ID. It is thus possible to identify that each of the mobile stations 11, 12, 21, 41, 42 and 43 is joining in the multicast group A with the group ID. Each of the mobile stations 11, 12, 21, 41, 42 and 43 respectively transmits the created response signal to the base stations 10, 20 and 40.

In step A, each of the base stations 10, 20 and 40 holds at least one response signal received from each of the mobile stations 11, 12, 21, 41, 42 and 43 for a predetermined duration.

In step 1004, each of the base stations 10, 20 and 40 selects at least one response signal from at least one response signal which is being held for the predetermined duration, and transmits the at least one selected response signal to the radio network controller 50 respectively.

In the embodiment, the base station 10 selects at least one response signal transmitted from the mobile station 11 for transmission to the radio network controller 50, the base station 20 selects at least one response signal transmitted from the mobile station 21 for transmission to the radio network

controller 50, the base station 40 selects at least one response signal transmitted from the mobile station 41 for transmission to the radio network controller 50.

In step 1005, the radio network controller 50 transmits service data to the base stations 10, 20 and 40 in accordance with the at least one response signal transmitted from each of the mobile stations 11, 21 and 41. In other words, the radio network controller 50 performs delivery controlling in accordance with the at least one response signal transmitted from each of the mobile stations 11, 21 and 41.

In step 1006, each of the base stations 10, 20 and 40 transmits the received service data to each of the mobile stations 11, 12, 21, 41, 42 and 43.

<A configuration of a radio communication system according to a third embodiment of the present invention>

The present invention is not limited to the above embodiments, and can be applied to a radio communication system according to a third embodiment which further comprises a response signal holder 10f and an initial response detector 10g as shown in FIG. 9.

The radio communication system according to the third embodiment is the same as the radio communication system according to the first embodiment except for the response signal holder 10f and the initial response detector 10g. Therefore mainly the difference between both radio communication systems will be explained.

The initial response detector 10g is configured to detect a first reception of at least one response signal received from

each of the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A.

In the embodiment, the response signal holder 10f holds the at least one received response signal for a predetermined duration (for example, a random duration) after the first reception of the at least one response signal.

The response signal creator 10d creates, in accordance with the at least one response signal which is being held for the random duration by the response signal holder 10f, at least one response signal to be transmitted to the radio network controller 50.

<An operation of the radio communication system according to the third embodiment >

Referring to FIG. 10, the operation whereby the radio network controller 50 performs a predetermined processing (for example, a service notice processing) on the mobile stations 11, 12, 21, 41, 42, 43 joining in the multicast group A in the radio communication system according to the embodiment will be described.

As shown in FIG. 10, in step 1001, the radio network controller 50 transmits a control signal such as a service notice signal and an authentication signal to three base stations 10, 20 and 40.

In step 1002, each of the base stations 10, 20 and 40 receives the control signal transmitted from the radio network controller 50. The control signals transmitted by each of the base stations 10, 20 and 40 reach the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A under the

base stations 10, 20 and 40.

In step 1003, each of the mobile stations 11, 12, 21, 41, 42 and 43 creates a response signal including a group ID. It is thus possible to identify that each of the mobile stations 11, 12, 21, 41, 42 and 43 is joining in the multicast group A with the group ID. Each of the mobile stations 11, 12, 21, 41, 42 and 43 respectively transmits the created response signal to the base stations 10, 20 and 40.

In step B1, each of the base stations 10, 20 and 40 detects a first reception of at least one response signal received from each of the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A.

In step B2, each of the base stations 10, 20 and 40 holds the at least one response signal which is received from each of the mobile stations 11, 12, 21, 41, 42 and 43 after the first reception for a predetermined duration after the first reception.

In step 1004, each of the base stations 10, 20 and 40 selects at least one response signal from at least one response signal which is being held for the predetermined duration after the first reception, and transmits the at least one selected response signal to the radio network controller 50 respectively.

In the embodiment, the base station 10 selects at least one response signal transmitted from the mobile station 11 for transmission to the radio network controller 50, the base station 20 selects at least one response signal transmitted from the mobile station 21 for transmission to the radio network controller 50, the base station 40 selects at least one response

signal transmitted from the mobile station 41 for transmission to the radio network controller 50.

In step 1005, the radio network controller 50 transmits service data to the base stations 10, 20 and 40 in accordance with the at least one response signal transmitted from each of the mobile stations 11, 21 and 41. In other words, the radio network controller 50 performs delivery controlling in accordance with the at least one response signal transmitted from each of the mobile stations 11, 21 and 41.

In step 1006, each of the base stations 10, 20 and 40 transmits the received service data to each of the mobile stations 11, 12, 21, 41, 42 and 43.

<A configuration of a radio communication system according to a fourth embodiment of the present invention>

The present invention is not limited to the above embodiments, and can be applied to a radio communication system according to a fourth embodiment which further comprises a response signal counter 10h and a comparer 10i as shown in FIG. 11.

The radio communication system according to the fourth embodiment is the same as the radio communication system according to the first embodiment except for the response signal counter 10h and the comparer 10i. Therefore mainly the difference between both radio communication systems will be explained.

The response signal counter 10h is configured to count the number of response signals transmitted from each of the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast

group A for a predetermined duration.

In the embodiment, three mobile stations 41 to 43 exist under the base station 40, so that the number of response signals (upward direction) to control signals (downward direction) transmitted from the base station 40 can be a value in a range from 0 to 3.

The comparer 10i is configured to judge whether the number of response signals transmitted from the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A is more than a predetermined number (a threshold) for a predetermined duration or not.

For example, when the predetermined number is "2" and the number of response signals transmitted from the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A is less than or equal to "2", the comparer 10i can judge that the response signals should be transmitted to the radio network controller 50, as they are.

When the predetermined number is "3" and the number of response signals transmitted from the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A is equal to "3", the comparer 10i can judge that at least one (for example, two response signals) response signal selected from the three response signals should be transmitted to the radio network controller 50.

The predetermined number (the threshold) can be determined by the base station 10 or the radio network controller 50.

In the embodiment, the response signal creator 10d creates, in accordance with the result (comparison result)

judged by the comparer 10i, at least one response signal to be transmitted to the radio network controller 50.

For example, the response signal creator 10d can be configured to transmit the at least one response signal received from the mobile stations to the transmitter 10e as they are, as the at least one response signal to be transmitted.

The response signal creator 10d can be configured to transmit at least one response signal to the transmitter 10e, as the at least one response signal to be transmitted.

<An operation of the radio communication system according to the fourth embodiment >

Referring to FIG. 12, the operation whereby the radio network controller 50 performs a predetermined processing (for example, a service notice processing) on the mobile stations 11, 12, 21, 41, 42, 43 joining in the multicast group A in the radio communication system according to the embodiment will be described.

As shown in FIG. 12, in step 1001, the radio network controller 50 transmits a control signal such as a service notice signal and an authentication signal to three base stations 10, 20 and 40.

In step 1002, each of the base stations 10, 20 and 40 receives the control signal transmitted from the radio network controller 50. The control signals transmitted by each of the base stations 10, 20 and 40 reach the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A under the base stations 10, 20 and 40.

In step 1003, each of the mobile stations 11, 12, 21, 41,

42 and 43 creates a response signal including a group ID. It is thus possible to identify that each of the mobile stations 11, 12, 21, 41, 42 and 43 is joining in the multicast group A with the group ID. Each of the mobile stations 11, 12, 21, 41, 42 and 43 respectively transmits the created response signal to the base stations 10, 20 and 40.

In step C1, each of the base stations 10, 20 and 40 counts the number of response signals transmitted from each of the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A for a predetermined duration.

In step C2, each of the base stations 10, 20 and 40 judges whether the number of response signals transmitted from the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A is more than a predetermined number (a threshold) or not.

When the counted number of response signals is less than or equal to the predetermined number, each of the base stations 10, 20 and 40 transmits the at least one received response signal to the radio network controller 50 as they are, in step 1004.

On the other hand, when the counted number of response signals is more than the predetermined number, each of the base stations 10, 20 and 40 transmits at least one response signal selected from at least one response signal to the radio network controller 50, in step 1004.

In the embodiment, the base station 10 selects at least one response signal transmitted from the mobile station 11 for transmission to the radio network controller 50, the base station 20 selects at least one response signal transmitted from the mobile station 21 for transmission to the radio network

controller 50, the base station 40 selects at least one response signal transmitted from the mobile station 41 for transmission to the radio network controller 50.

In step 1005, the radio network controller 50 transmits service data to the base stations 10, 20 and 40 in accordance with the at least one response signal transmitted from each of the mobile stations 11, 21 and 41. In other words, the radio network controller 50 performs delivery controlling in accordance with the at least one response signals transmitted from each of the mobile stations 11, 21 and 41.

In step 1006, each of the base stations 10, 20 and 40 transmits the received service data to each of the mobile stations 11, 12, 21, 41, 42 and 43.

<A configuration of a radio communication system according to a fifth embodiment of the present invention>

The present invention is not limited to the above embodiments, and can be applied to a radio communication system according to a fifth embodiment which further comprises a response signal counter 10h, a comparer 10i and a comparison result adder 10j as shown in FIG. 13.

The radio communication system according to the fifth embodiment is the same as the radio communication system according to the fourth embodiment except for the comparison result adder 10j and the configuration of the radio network controller 50. Therefore mainly the difference between both radio communication systems will be explained.

The comparison result adder 10j is configured to instruct the response signal creator 10d to notify information showing

the comparison result acquired by the comparer 10i, that is, information showing the result of judging whether the number of response signals transmitted from the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A is more than a predetermined number (a threshold) for a predetermined duration or not, to the radio network controller 50 together with the response signals.

For example, the response signal creator 10d creates at least one response signal including information showing that the counted number of response signals is more than the predetermined number or information showing that the counted number of response signals is not more than the predetermined number, in accordance with the instruction from the comparison result adder 10j.

The response signal creator 10d can create, in accordance with the instruction from the comparison result adder 10j, at least one response signal including the counted number of response signals.

As shown in FIG. 14, the radio network controller 50 is configured with a receiver 50a, a response signal extractor 50b, a radio controller 50c and a transmitter 50d.

The receiver 50a is configured to receive the response signals transmitted from each of the base stations 10 to 40.

The response signal extractor 50b is configured to extract the information showing that the counted number of response signals is more than the predetermined number, or the counted number of response signals, from the response signals received by the receiver 50a.

The radio controller 50c is configured to perform a radio

controlling in multicast communication, in accordance with the extracted information or the extracted number of response signals.

For example, the radio controller 50c can be configured to perform delivery controlling on the plurality of mobile stations joining in the multicast group A, using common circuits, when the signal merging the response signals received from the mobile stations joining in the multicast group A into one is transmitted, that is, when the information showing that the number of response signals is more than the predetermined number is extracted from the received response signal.

On the other hand, the radio controller 50c can be configured to perform delivery controlling on the plurality of mobile stations joining in the multicast group A, using each individual circuit, when the response signals received from the mobile stations joining in the multicast group A is transmitted respectively, that is, when the information showing that the number of response signals is more than the predetermined number is not extracted from the received response signal.

The present invention can provide a base station, a mobile station, a base station and a radio network controller used in a radio communication system which can reduce the load on the radio network controller during the multicast communication.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and the representative embodiment shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive

concept as defined by the appended claims and their equivalents.